

JPRS 77966

30 April 1981

USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 82

FBIS

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30 April 1981

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ANTENNAS

UDC 621.391.26

EFFECT OF THE ANTENNA ARRAY CONFIGURATION ON THE SPACE (DISTANCE) RESOLUTION OF RADIATION SOURCES

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 11, Nov 80 pp 1351-1359 manuscript received 22 Oct 79

KREMER, N. Ya. and PETROV, V. M., Voronezh State University

[Abstract] Space resolution of radiation sources by a ranging antenna is possible because of the different curvatures of the signal wavefront at the receiver end, depending on the traveled distance. Here two antenna arrays are evaluated with respect to the minimum number of elements they require for an unambiguous measurement of distance within a given range. Accordingly, an expression is derived for the distance autocorrelation function of a space-time signal and this function is then calculated for a cruciform array and for a ring array, each assumed to receive a narrow-band signal with a spherical wavefront. The minimum number of elements is found to be somewhat smaller for a ring array than for a cruciform array and much smaller for both than for a uniform planar array. In the case of a large antenna or in the case of a wide signal spectrum the assumption of space-time narrowness is not valid and the autocorrelation function depends on the signal form. An appropriate correction must be made for each array configuration, but this correction is found to be significant only in the case of antennas with a high space resolving power. Figures 5; references 6: 5 Russian; 1 Western in translation.

[178-2415]

PROTECTING THE MAIN LOBE IN ADAPTIVE ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 8-19 manuscript received 7 May 80

PISTOL'KORS, A. A.

[Abstract] An earlier algorithm derived by the author [RADIOTEKHNIKA, 1979, No 5] for the optimization of the useful signal-to-noise ratio in an adaptive receiving linear antenna array of N identical equally spaced dipoles suffered the defect that the useful signal incoming via the main lobe is also suppressed. Possible approaches to main lobe protection have included the insertion of a network of L amplifiers in each dipole, separated by $L - 1$ delay lines; the optimality criteria in the choice of the delay line and amplifier parameters was a minimum level of all received noise, including the signal, with the exception of the main lobe, for which N weighting factors are used. The present paper treats a technique of main lobe protection which precludes the use of delay lines and uses only N regulators for the weighting factors, which vary not only the amplitude but also the phase of the received signal. The useful signal is assumed to be incoming perpendicular to the array axis and the voltages picked off of the dipoles in the absence of interference are added with identical amplitudes and phases. The detailed mathematical treatment derives analytical expressions for the optimal weighting factors in the case of one or two noise sources. The direction finding properties of such adaptive arrays are quantitatively defined in terms of the improvement in the narrowness of the main lobe when DFing a single noise source as well as a coded signal against the background of internal array noise. Practical approximations are found for this internal noise in the latter case, as well as the directional pattern for the worst case noise condition, i. e. where the absolute values of the weighting factors simultaneously attain their maximum values. The improved resolving power of adaptive arrays is illustrated by a comparison of the noise level in two cases: 1) A single noise signal incoming via the main lobe; and 2) A pair of noise sources are positioned symmetrically on each side of the main lobe. The factor by which the angular resolution of the distance between the sources with adaptive arrays over nonadaptive arrays is presented in tabular form for various system parameters. Figures 3; tables 2; references 6: 1 Russian; 5 Western.

[147-8225]

IMPROVING THE NOISE IMMUNITY OF ANTENNAS BY MEANS OF SPECIAL SHIELDS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 19-23 manuscript received after completion 6 Dec 79

MEL'NIKOV, Yu. M. and YAMPOL'SKIY, V. G.

[Abstract] The front-to-rear ratio of antennas in radio relay links should be no less than -65 to -70 dB, a requirement which conventional, axially symmetric antennas do not meet in a wide sector of angles to the rear. This difficulty can be circumvented by using a metal disk shield mounted on the back of the reflecting dish. An analytical expression is derived for the attenuation provided by such a shield, written as a function of the spacing between the edges of the shield and the dish, the angle between the direction to the edge of the shield and the 180° line to the rear from the main lobe. The additional gain in the rear suppression is shown graphically. A slotted ring mounted on the back of a dish can also provide shielding which improves the front-to-rear ratio even more; the operational principle of such a shield rests on the compensation for the field from the edge of the shield by the field passing through the annular slot. Simple analytical expressions for the slot geometry as a function of the antenna dimensions and the wavelength are derived. The conditions under which this configuration provides large attenuations are specified. A sample calculation is given for an annular slotted shield mounted on the back of a dish at a distance of 10 wavelengths from the edge of the axially symmetric dish, where the annular outside made of a radio-opaque material has a width of 1.88 wavelengths with a slot width of 0.6 wavelengths. The rear field suppression by the shield was checked experimentally by an antenna with an aperture angle of 120° and a diameter of 138 wavelengths. The shield yielded a suppression of the rear lobe by about 15 dB while the other lobes of the pattern were not affected. The directional patterns are shown graphically before and after the shield is added; it is noted that the slotted shield is more efficient than the continuous one, suppressing radiation in directions close to the axis of symmetry more effectively, although the suppression sector is smaller. An experimental study of the minimum possible dimensions of the slotted shield show that it is quite effective even if the distance at which it is mounted from the edge of the antenna is no more than 1 to 2 wavelengths. Figures 9; references: 6 Russian.

[147-8225]

OPTIMIZATION OF THE SIGNAL-TO-NOISE RATIO IN ANTENNA ARRAYS LOCATED NEAR GROUND

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 11, Nov 80 pp 1382-1385 manuscript received 18 Dec 79

YERMOLAYEV, V. T., KRASNOV, B. A. and FLAKSMAN, A. G.

[Abstract] The problem of optimizing the signal-to-noise ratio in antenna arrays near ground is solved, taking into account both reflection and absorption by the earth surface. Specifically a linear array of N elements is considered with the phase distribution of currents matching the phase distribution of the field of the signal source in the aperture. The noise at the antenna output consists of three components, namely intrinsic noise in the receiver, noise from the signal sources above ground, and earth noise. The resultant noise power is calculated according to Kirchhoff's law and using the Poynting vector. The signal power at the antenna output is calculated, assuming a linear, say horizontal, polarization of the radiators with zero component of the electric field intensity parallel to the plane of incidence also with the use of the Poynting vector. The ratio of the signal power to the noise power is then maximized with respect to the amplitudes of the excitation currents, this problem of optimization being reduced to a system of linear algebraic equations. Typical results are shown for an antenna array consisting of $N = 8$ elements. The authors thank Yu. M. Zhikdo for helpful discussions. Figures 2; references 5: 4 Russian, 1 Western. [178-2415]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT
WARE: CONTROL, AUTOMATION, TELEMCHANICS,
TELEMETERING, MACHINE DESIGNING AND PLANNING

UDC 531.768.681.3.01

THE ELECTRONIC COMPUTER SYSTEM FOR AN ABSOLUTE LASER GRAVIMETER

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 38-45 manuscript
received 17 Sep 79

KALISH, Ye. N., Novosibirsk

[Abstract] The first Soviet gravimeter for high precision determinations of the absolute value of g based on a body in free fall in the earth's gravitational field was designed and fabricated in the early 1970's at the Institute of Automation and Electrometry of the Siberian Department of the USSR Academy of Sciences. All gravimeters using ballistic techniques for the measurement of g consist of three basic units: a ballistics unit which provides for the free fall of a body, an optical system designed for recording the position coordinates of the moving body (using a laser interferometer) and an electronic computer system which measures the free fall parameters and computes the value of g . This paper is a detailed description of the circuitry of the computer used in the above gravimeter. The system is broken down into two major structures: one contains the photodetector, a linear amplifier, a preliminary frequency divider and a count start delay circuit, all incorporated in the interferometer module, while the other contains the time interval drivers (the interference band counters), the time interval meters (timers), the high-frequency generator with the Ch1-30 frequency standard and an interface which are designed to CAMAC standards and built on two circuit boards in a 48 module. The functional algorithms are described and the expressions used in the computer to figure the mean arithmetic value of the series of measured values and the mean square error in the measurements are also given. The planned improvement in the vibrational protection for the gravimeter in order to increase the measurement precision also necessitates improving the relative precision in the time interval measurements, i. e., boosting the resolving power of the counters used. Figures 7; references 6: 4 Russian; 2 Western.
[120-8225]

THE ANALYSIS OF DIGITAL DETECTION SYSTEMS BY MEANS OF DIGITAL COMPUTER MODELING

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 66-69 manuscript received 28 May 80

POPOV, D. I.

[Abstract] The presence of nonlinear elements in the signal processing channel of digital detection systems limits the applicability of analytical methods, and necessitates the use of statistical modeling with digital computers. This paper treats the modeling of the components of a radar detection channel: it reduces to the construction of processing algorithms which adequately describe the flow of the signal and interference mixture through the channel, where the mixture is modeled by a sequence of complex sample readouts. The receivers, which have either amplitude limiting or a logarithmic amplitude response used for dynamic range compression, are simulated with the appropriate inertialess envelope transforms. In determining the probabilistic characteristics of such detection systems, computer time requirements are reduced as compared to the classical Monte-Carlo procedure by means of the use of a priori information on the distribution of certain signal statistics, which represent the probability function in the form of a series expansion of polynomials, orthogonal relative to the weighting functions. The algorithms derived through stochastic approximation compute current estimates in step with the arrival of the information, which makes it possible to optimize the requisite accuracy and smooth the estimates where desired. Such an approximation algorithm is derived for the optimization of binary quantized signal detectors, where it is necessary to determine the input signal-to-interference ratio, q , using a specified detection probability D . The resulting algorithm is applied to a digital detection system with a second order recursive rejection filter for two types of detectors: 1) A 'moving window' detector; and 2) A programmed detector based on a '3/5/' criterion. The assumed interference spectrum is Gaussian, the noise-to-interference ratio is 10^{-3} , the signal is a fluctuating one and the detection threshold is $D = 0.5$. The value of D is plotted as a function of q in dB and it is shown that the '5/10' criterion is about 2 dB superior to the '3/5' criterion in this case. Figures 2; references: 6 Russian.

[147-8225]

THE AUTOMATIC RECOGNITION OF IMAGES RECEIVED FROM OBJECTS HAVING ROUGH AND MIRROR SURFACES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 15-19 manuscript received 6 Feb 78, final version 3 Jan 79

TIKHOMIROV, V. A., TROITSKIY, I. N. and KHARITONOVA, O. I., Moscow

[Abstract] The problem of image recognition from objects with mirror and rough surfaces using coherent light is treated for the case where the optical imaging resolution and energy are low. The image of a mirror object takes the form of a determinate picture including one or more bright spots, depending on the shape and the observation aspect. The registered image, which is broken down in the raster of the analyzer into N elements, is a set of random integers, n_i , equal to the number of photoreadouts in the raster elements. The numbers n_i occur with probabilities governed by Poisson's distribution. The image of a rough surface object consists of a set of points with random brightness values, and in this case the average size of a spot is equal to a resolution element of the optical system. Images obtained with minor changes in the conditions (aspect, wavelength and illuminator rotation) are not correlated. The probability distribution of n_i in the recorded image is described by Bose-Einstein statistics, where the optics resolving elements are equal to the analyzer raster and the registration time is less than the coherency time of the light source. Optimal algorithms are found for the recognition of such images based on statistical decision making theory. The problem can be formulated either as one involving the testing of the hypothesis that the set of values of n_i is a Poisson process (H_1) with a probability density function F_1 as opposed to the alternative that the set of n_i obeys Bose-Einstein statistics (hypothesis H_0 , F_0), or as a problem involving the testing of H_1 in the case of a free alternative. Both cases are analyzed and the algorithms exhibit good efficiency; the possibility of using simple algorithms for the recognition of images from mirror objects in the free alternative case is demonstrated. The algorithm efficiencies are plotted for values of $N = 5, 7$ and 10 showing $P(H_1/H_1)$ as a function of $P(H_1/H_0)$ (the probability of a correct determination of a mirror type reflection vs. the probability of an erroneous decision that the reflecting object is a mirror type). A brief discussion of nonoptimal algorithms indicates that even simpler heuristic recognition algorithms are possible which come close to the optimal ones in terms of efficiency. No experimental data are adduced. Figures 2; references 6: 4 Russian; 2 Western (1 in translation). [120-8225]

UDC 621.376.4:621.316.726

DIGITAL PHASE DETECTORS BASED ON FRACTIONAL FREQUENCY DIVISION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 28-32 manuscript
received after completion 24 Mar 80

KOSLOV, V. I.

[Abstract] Previous western literature has described a technique for stabilizing a discrete set of frequencies using a phase-locked loop, which includes a frequency divider with a fractional division factor. Fractional division entails the appearance of interference at the phase detector output which this paper terms the fractionalization noise; such noise is traditionally compensated for by out-of-phase summing of the phase mismatch signal and the process representing the storage of the fractional portion of the dividing coefficient, which is converted to analog form. The precision of this analog compensation depends on the precision of the setting and the stability of the transfer functions of the phase detector, the D/A converter and the weighting factors during the summing. After discussing the principles underlying the analog compensation circuitry, a digital compensation technique is proposed which circumvents the above difficulties. The operational logic of the proposed device is described in detail. The modification consists in compensating for the fractionalization interference in digital form prior to deriving the phase mismatch signal in analog form. Inasmuch as summing and D/A conversion are linear operations, the problem is solved using a superposition principle by changing the sequence of the operations. A circuit where the summing and code switching operations are accomplished separately is also described, which provides a slight gain in the dynamic compensation precision. No experimental checks are indicated although it is noted that the modified digital phase detectors proposed here can be designed entirely around logic gates and are amenable to solid-state technology. Figures 8; references: 3 Western, 1 Czech.
[147-8225]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS
AND TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA
TRANSMISSION AND PROCESSING, INFORMATION THEORY

UDC 535.318:681.4

A METHOD OF SWITCHING OPTICAL COMMUNICATION CHANNELS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 107-108 manuscript
received 9 Jun 78

LI, S. K., Leningrad

[Abstract] The use of microholograms for switching optical communication channels is impractical because of the lack of suitable bidirectional media for microhologram storage and for other reasons. This paper treats the more feasible approach of optical communication channel switchers based on optoelectronic optically controlled transparencies. An analysis based on set theory defines the various regions and specifies the arguments or functions governing the channel switching. Two transparency configurations are sketched: one continuous and one discontinuous with breaks in it. In the case where K transparencies are used, the operationally timely generation of the region specifying the arguments (or functions) is possible with K breaks in the specified dimensions of the transparency plane. The very brief and general theoretical treatment does not provide sample calculations or experimental data. Figures 3.

[120-8225]

UDC 621.2.08

REDUCING THE DYNAMIC ERROR OF ANALOG-TO-DIGITAL CONVERSION BY MEANS OF COUNT
READOUT PROCESSING

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 87-89 manuscript received
20 Mar 80

LITVINOV, N. V., Novosibirsk

[Abstract] The dynamic error resulting from the analog-to-digital conversion of signals with a wide spectrum increases rapidly with an increase in the first

derivative of the signal, something which makes such conversion readouts practically unsuitable for restoration. The use of analog memories at the analog-to-digital converter input can substantially reduce the dynamic error and expand the bandwidth of the convertible signals, although it is difficult to design fast analog memories having good accuracy. Accordingly, this paper studies the possibility of reducing the dynamic error by means of processing the count readouts derived during analog-to-digital conversion. Such processing is especially useful where real time data processing is not required. The simplest procedure for processing adjacent readouts is analyzed based on an analog-to-digital conversion model which takes the form of an ideal quantizer connected in series with a variable delay network. A simple processing algorithm is derived and its efficiency is shown to be inadequate through computer modeling using the ratio of the dispersion of the dynamic error of the readouts without processing to the dispersion with processing as the criterion. A second expression is written for the dynamic error in the case of scanning compensation analog-to-digital conversion, where the readout processing efficiency is substantially higher because of the more precise determination of the signal derivative from two readouts. The computer modeling of this formula shows that the dispersion of the dynamic error of the corrected readouts is smaller by a factor of 900 than the dispersion of the readouts without correction. For analog-to-digital conversion with 1,024 quantization levels in amplitude and a signal increment over the conversion time of ± 102 quanta, the dispersion of the readout error without processing was $234q^2$ and $0.26q^2$ with processing (q is the level quantization step). Figures 2; references: 3 Russian. [120-8225]

UDC 621.376.57

CONCERNING THE PRECISION OF A MARKOV APPROXIMATION OF A DISCRETE SIGNAL OF A LINEAR DELTA MODULATION DURING VOICE TRANSMISSION

Moscow RADIOTEKHNICA in Russian Vol 36, No 1, Jan 81 pp 24-28 manuscript received after completion 5 Jun 80

KHMELEVSKIY, I. V. and GEORGIYEVSKIY, A. Ye.

[Abstract] The advisability of approximating a delta transformation of a voice communication by a stationary double-connected Markov chain is theoretically and experimentally confirmed. The proximity of a model to a real process is evaluated by the value of the stiffness factor and the Kulbak information numbers, as well as by the results of digital and physical modeling of the optimum non-linear algorithms for separation of a delta modulation signal on a background of wideband Gaussian noise. Tables 3; references: 8 Russian. [181-6415]

DETERMINATION BY A FILTER OF THE MOMENT OF APPEARANCE OF AN INFRARED FLUCTUATING SIGNAL

Moscow RADIOTEKHNIKA in Russian Vol 36, No 1, Jan 81 pp 33-34 manuscript received 18 Feb 80

DOLININ, N. A.

[Abstract] A 1970 paper by S. Ye. Pal'kovich demonstrates that in the case of additive noise, a system which uses the location of the principal maximum of a signal at the output of a linear filter is optimum for evaluation of the moment of arrival of a signal. In the present paper an evaluation system is considered, the input of which is an inertial element which smooths the rapid fluctuations of the input signal. In this case the multiplicative component of the noise caused by fluctuations of the useful signal is small and it is probable that an evaluation of the moment of arrival of a pulse with respect to the principal maximum at the output of a linear filter will be sufficiently effective. The filtration system which achieves the principal maximum of a signal, with the object of determining the moment of its appearance, is simple and consists of a linear filter at the input and a filter which localizes the principal maximum of the signal. As the second filter, it is possible to use a filter with any characteristic. However, it is sound practice to incorporate in the circuit a filter with a Gaussian transient response, most sharply realizing the principal maximum in the case of adaptive white noise. Consequently, it is possible to hope that in the case considered a circuit with a bell-shaped weight function will be optimum. References: 4 Russian. [181-6415]

EVALUATION OF NOISE IMMUNITY OF START-STOP METHOD OF TRANSMISSION OF DISCRETE MESSAGES

Moscow RADIOTEKHNIKA in Russian Vol 36, No 1, Jan 81 pp 69-71 manuscript received after completion 28 Apr 80

GLOBUS, I. A.

[Abstract] During start-stop transmission of discrete messages, each code combination is preceded by a starting (synchronizing) signal which fixes the moment of origin of an information block. Time synchronization during demodulation of the information digits is assured by a local generator of the reading moments, the single start-up of which takes place at the moment of appearance of the start signal. After delivery by the generator of a given number of readout points,

the receiver goes back to a slave mode. The problem arises of optimization of the energy of the start-stop signal. The present paper is concerned with the solution of this problem on the basis of the criterion of the maximum probability of accurate reception of a code combination. An adaptive Gaussian channel is considered. It is proposed that the pause between code combinations exceeds the duration of the latter, that a T-th system of orthogonal signals is used in the information block, and that reception is noncoherent. References: 7 Russian. [161-6415]

UDC 621.391.1.072.9

IMPROVING THE PRECISION OF TIME SYNCHRONIZATION IN ATMOSPHERIC OPTICAL COMMUNICATIONS LINKS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 75-77 manuscript received 18 Nov 79

BORISOV, E. V. and NEZHEL'SKIY, A. S.

[Abstract] An optical pulse with a width of $2t$ is observed with variations in its position of δt . This delay is tracked by a dynamic system, the output signal of which serves for the time synchronization of the optical communications link. The input signal to the tracking system is represented as an integral function of the photo-electron flux intensity at the photodetector output, equal to the sum of the signal and noise components. This system is analyzed in a linear approximation, taking only additive noise into account, producing an expression for the dispersion of the normalized delay, corresponding to an error in a feedback loop. Atmospheric turbulence is responsible for fluctuations in the optical radiation, which can be described by a normal distribution of the logarithm of the relative amplitude. The averaged value of the dispersion of the normalized delay is found for the practical case of slow fluctuations. This is then used to estimate the degradation of the precision of the time synchronization caused by the turbulence. A method of reducing the impact of the atmosphere on the time synchronization precision is discussed and an estimate is made of the potential effectiveness of the proposed technique. No sample calculations or experimental data are given. Figures 1; references: 5 Russian. [147-8225]

A METHOD OF IMPROVING THE INTERFERENCE IMMUNITY OF SIGNAL RECEPTION UNDER CONDITIONS OF NEAR-FIELD INTERFERENCE

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 11, Nov 80 pp 1314-1317 manuscript received 12 Mar 80

GUT, R. E., MINEVICH, M. L., SOBCHAKOV, L. A. and UDAL'YEV, Yu. E.

[Abstract] Suppression of near-field interference by processing the space spectrum of signals in a receiver antenna has not been very successful, essentially because in this case the radiation pattern does not adequately characterize a receiver antenna. Here a method of improving the immunity of signal reception to near-field interference is proposed which utilizes the fundamental change occurring in the functional relation between the electric field component and the magnetic field component as the distance from the signal source increases. Although in the far zone both components of the interference field are the same function of time, as are both components of the signal field, in the near zone the relation between the two field components is that between a function and its derivative. Accordingly, two antennas rather than one are installed at the receiver end. The corresponding algorithm of extracting the useful signal from far-field interference as well as near-field interference is found to be invariant with respect to the latter. It is a purely heuristic algorithm, not based on the method of optimal synthesis, but it also ensures potential immunity to far-field interference. References: 2 Russian.
[178-2415]

ON THE IMPACT OF THE KIND OF NOISE DISTRIBUTION ON THE QUALITY OF DETERMINATE SIGNAL DETECTION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 70-72 manuscript received 20 Jan 80

SHLYAKHIN, V. M.

[Text] Inasmuch as the distribution of certain types of interference differs from a normal distribution, including such clutter as atmospheric radio noise, returns scattered by an agitated sea surface, etc., this paper studies the influence of non-normal noise distributions on signal detection in order to ascertain the probabilistic characteristics of useful signal detection against a background of such interference and to determine the changes caused by the non-normal nature of the distribution. General analytical expressions are written for the interference distribution functions which can generate Rayleigh, single dominant plus

Rayleigh, Maxwell-Boltzmann and Nakagami distributions, depending on the choice of parameters in the functions. The detection characteristics of a determinate signal in additive noise is analyzed using these functions in the general case. For a threshold level other than zero, the non-Gaussian nature of the interference increases the false alarm probability, and when the useful signal exceeds the threshold, the result is a substantial reduction in the detection probability as compared to the case of signal detection in normal additive noise. The quantitative impact of the non-normality is illustrated graphically, though no sample calculations or experimental data are adduced. References 6: 4 Russian; 2 Western.
[147-8225]

UDC 621.391.17+621.378.3

THE INFLUENCE OF THE WAVEFORM AND ON-OFF TIME RATIO OF OPTICAL PULSES ON THE SIGNAL-TO-NOISE RATIO IN LASER COMMUNICATIONS LINKS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 77-82 manuscript received 3 Nov 79

ALISHEV, Ya. V. and BERKUTOV, A. A.

[Abstract] In laser communications links with frequency modulation of the sub-carrier and direct photodetection, the noise immunity can be boosted because the output signal is governed by the repetition rate, phase or width of the sub-carrier pulses and depends little on multiplicative interference. This paper derives analytical expressions for the pulse shape, the normal spectral function of the output pulse of the detector, the voltage of the fundamental of the sub-carrier frequency, the optical signal power gain, the relative attenuation of the shot noise power and the gain caused by the particular type of pulse modulation for the following pulse waveforms: trapezoidal, rectangular, triangular, cosine, cosine squared, cosine cubed and cosine with square law rounding. Trapezoidal waveforms are the most efficient in terms of energy and in the case of an on-off time ratio of 3, the subcarrier power gain over the case of linear modulation, taking shot noise limitations into account, is about 1.85. Although the waveforms and relevant analytical formulas are summarized in an extensive table, no sample calculations or experimental data are provided. Figures 2; tables 1; references: 6 Russian.
[147-8225]

THE NOISE IMMUNITY OF OPTICAL DETECTORS USING NEUMANN ALGORITHMS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 72-75 manuscript received 25 Dec 79

TOLPAREV, R. G. and POLYAKOV, V. A.

[Abstract] Slow fluctuations in the probability distribution parameters of the signal and noise at the input are characteristic of optical band detectors. An optimal algorithm derived by the authors in an earlier paper [RADIOTEKHNIKA, 1977, Vol 32, No 8] for the case where the indicated parameters were constant, but a priori unknowns, estimated the noise distributions and computed the threshold in each locally steady-state time interval. However, this adaptive detection procedure requires large noise samples for normal operation, which is possible only when t is much greater than the signal observation time. Because this is infrequent in practice and the algorithm is difficultly feasible, this paper presents a technique for the derivation of Neumann detection algorithms and estimates their operational efficiency under actual conditions. Such algorithms permit the relatively simple derivation of uniformly most powerful unbiased rules relative to the parameter being checked for the detection of optical signals and provide for a constant false alarm probability with constant but unknown or changing noise distribution parameters at the optical detector input. The procedure is based on the analysis of coherent signal detection against a background multimode thermal noise for the case where the product of the signal observation time interval and the difference between the average frequencies of the signal and noise spectra is much less than unity. Analytical expressions are found for the operational quality of such algorithms in terms of its 'power function' as well as the distribution of the mean value of the noise. The adaptive algorithm is more general than the previous one under real conditions and simpler, requiring no changes during operation. Figures 2; references 6: 5 Russian; 1 Western.
[147-8225]

A HIGH SPEED TECHNIQUE FOR GENERATING M-SEQUENCES

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 42-44 manuscript received 23 Apr 80

BUGAYETS, Ye. S.

[Abstract] The maximum speed of M-sequence generators using shift registers with linear feedback loops is limited to the speed of one shift register digit.

More complex configurations can improve the speed: 1) A technique generating M-sequences at a rate of kF by modulo two summing of k sequences at a speed of F is described in western literature; and 2) A second proposal by A. Y. S. Quan [TRANS. IEEE 1974, Vol C-20, No 2] involves replacing the modulo 2 summing by time multiplex operation using a multiplexer to boost the maximum generator speed if the components are chosen from the same series of IC's. The present paper is a theoretical proof of the justification for the second approach, and the possibility of refining its realization is demonstrated. A proposed circuit is drawn as a block diagram and the following experimental check is made: An M-sequence generator designed around KT391 transistors, with $k = 4$, operates at a speed of 0 to 1,000 Mbit/sec. An oscilloscope trace of the output signal is shown, indicating a peak-to-peak value of about 1.5 volts and a 1 nsec rise time. It is indicated that transistors exist which can boost the maximum generator speed up to 2,000 Mbit/sec. Figures 2; references 6: 2 Russian, 4 Western. [147-8225]

UDC 621.391.266

THE IMPACT OF A NOISE SUPPRESSOR ON THE OUTPUT SIGNAL OF AN OPTIMAL FILTER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 23-28 manuscript received after completion 18 Feb 80

BOKK, O. F. and GARMONOV, A. V.

[Abstract] Concentrated noise suppressors which reject portions of the spectrum subject to narrow-band interference can be used to boost the noise immunity of complex signal reception. Such rejection distorts the signal correlation function. The present paper derives expressions for the distortions in the correlation function of a complex signal in the case where the suppressor consists of parallel channels with complex transmission coefficients, the outputs of which are connected via switches to the inputs of an adder. A filter having a complex transmission coefficient, which is the complex conjugate of the signal spectrum, is connected to the output of the adder. This configuration is analyzed for the case where narrow band interference is both present and absent. An experimental check was made in which the absolute value of the signal envelope at the output of a matched filter with a 10-channel noise suppressor having the odd channels cut out was employed. The pulse response of an individual channel was close to the pulse response of a 6th order Butterworth filter, and phase inverters with a phase shift of 180° were inserted into the odd channels of the suppressor. The formula derived for the matched filter output signal with the noise suppressor at its output makes it possible to determine the signal distortions and to estimate the impact of the form of the signal spectrum, as well as the shape of the amplitude-frequency and phase-frequency responses of the channels on the level of these distortions. The envelope distortions do not fall outside the

envelope of the pulse response of an individual channel of the suppressor. The region of greatest distortion is defined as well as conditions which must be met to reduce the input signal distortions and increase the major response peak. Figures 3; references: 12 Russian.
[147-8225]

UDC 621.395.74.001.1

OUTLOOK FOR THE DEVELOPMENT OF URBAN TELEPHONE CABLES

Moscow ELEKTROTEKHNIKA in Russian No 10, Oct 80 pp 21-24 manuscript received 4 Mar 80

RYSIN, L. G., engineer, and SHARLE, D. L., candidate of technical sciences

[Abstract] Cables produced for urban telephone networks are of the low-frequency class (300-3400 Hz). The problem of material economy, primarily of saving copper and lead, is being met by size reduction, substitution of less scarce metals, and by various modifications in cable technology and operation. Reduction of the conductor diameter from 0.4 to 0.32 mm, as planned for the early years of the eighties, should save 37% copper and provide space for 2400 instead of 1200 conductor pairs in a cable of the same 75-80 mm size. Aluminum for replacement of copper, because of its inferior electrical and mechanical as well chemical characteristics, must be alloyed with other elements such as copper, zinc, iron, magnesium, silicon, or manganese. Another promising alternative is an aluminum-copper bimetal: an aluminum wire core coated with a 0.1-0.3 mm thick copper layer. One drawback here is a faster corrosion, unless the coating is perfect, especially at the open ends. The cable conductors are insulated either with solid polyethylene or with paper and air. Under study is the feasibility of using porous polyethylene, which is more economical but requires a special wrapping process or a hydrophobic filler. Hermetic sealing of such an insulation is particularly effective in cables with not more than 100 conductor pairs. The inevitable incompatibility between porous polyethylene and hydrophobic filler can be alleviated by combining porous and solid layers of insulation, but this makes the conductor twisting process more difficult. Either pair twisting or quad twisting is acceptable, the progressive process being now regarded as basic but not yet having been standardized. As armor material, in the case of cables with paper and air insulation, a corrugated steel shell made of steel tape and protected by a polyethylene sleeve will eventually replace lead. Figures 1; tables 3.
[160-2415]

NONLINEAR FILTRATION ALGORITHMS FOR A NOISY PHASE-MODULATED SIGNAL ON A BACKGROUND OF SIMILAR NOISE

Moscow RADIOTEKHNIKA in Russian Vol 36, No 1, Jan 81 pp 76-78 manuscript received after completion 19 Apr 79

BESEKERSKIY, V. A., OVODENKO, A. A. and SHEPETA, A. P.

[Abstract] The problems are considered of constructing filtration algorithms for a noisy phase-modulated signal on a background of similar noise. A mathematical formulation of the problem, the use of the principles of invariance, and a nonparametric approach are discussed. The nonlinear filtration algorithms obtained here for noisy phase-modulated signals possess the property that the probability of appearance of a signal at the output of the filters, which implements the algorithms in question during action at the input of the noise filter P_0 , is constant and not a function of the noise characteristics. References: 7 Russian.
[181-5415]

AN AUTOMATIC DATA PROCESSING SYSTEM FOR A RADIOMETRIC MULTICHANNEL FLAW DETECTOR

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 73-76 manuscript received 9 Apr 79, final version 9 Jul 79

BUTAKOVA, G. Ye., TEMNIK, A. K. and CHEKALIN, A. S., Tomsk

[Abstract] Nondestructive flaw detection of objects with complex profiles using a radiometric flaw detector produces useful and interfering signals with overlapping spectra. This necessitates the use of digital signal processing based on image recognition theory in order to ascertain the significant signal criteria as a function of the defects and to implement complex detection algorithms. This paper describes an automated data processing system for a multichannel radiometer flaw detector which realizes one such complex algorithm. The system is designed around the CAMAC modular trunk system and includes a programmable controller which performs functions relating to data exchange via the trunk and calculations using the program stored in the immediate access memory, and also controls overall system operation in real time. The analog signal from the flaw detector is converted to a binary code in an A/D converter. The converter is connected to the next flaw detector channel by means of an analog switcher, controlled by the working routing. The quantization time for the process is set by a timer; when a query arrives from the timer, the controller reads the data from the A/D converter, writes the number of the next channel into the switcher, triggers

the converter and changes over to processing the incoming data. The flaw detection program is stored in the PROM, which is built as a separate module in order to provide for timely changing of the system algorithm. When a flaw is detected, the controller reads the data from a coordinate transducer module which determines the position of the flaw detector collimators relative to the origin of the product under test. The parameters of the detected flaws are fed out to the EUN-23 printer via a printer interface. The functions of these components are discussed in more detail using block diagrams of the system as a whole, the program controller and the structure of the various addressing instructions. Figures 3; references: 3 Russian.
[120-8225]

UDC 681.142.621

ON THE DYNAMICS OF INTEGRAL SAMPLING DEVICES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 81-85 manuscript received 9 Oct 79, final version 14 Mar 80

KASPEROVICH, A. N., Novosibirsk

[Abstract] An integrating sampling and storage device does not store the instantaneous value of a signal, but its average value over the sampling or integration time. It operates in three stages as opposed to the two steps of conventional instantaneous value sampling and storage instruments: 1) Integration; 2) Storage, during which the analog-digital conversion is accomplished; and 3) The return of the integrator to the original state. This paper studies such devices in order to ascertain how the instantaneous and average values (over the sampling time) of a signal are related and how the instantaneous values can be restored from the average ones. An integral sampling device is represented as a 'sliding' integrator and an expression is adduced for the amplitude-frequency response. In order to compensate for distortions, a filter must be used which has an amplitude-frequency response, the inverse of that of the sampling device. The possible characteristics of a digital filter for this purpose are described and it is noted that a fully correcting digital filter is not feasible. A feasible filter with a finite number of values of pulse response can be obtained by truncating and shifting the amplitude-frequency response of the requisite ideal filter. In order to estimate the correcting properties of possible digital filters, the amplitude-frequency characteristics were determined for a series-connected integral sampler and some synthesized filters (with a Hamming window). The use of filtering substantially reduces the frequency errors of such devices. The expediency of using such instruments for the measurement of instantaneous signal values is governed by their instrument errors, because the procedural frequency errors of such devices can be reduced to acceptable levels by comparatively simple processing. Figures 2; tables 1; references: 2 Russian.
[120-8225]

DIFFERENCE DIFFERENTIATION WITH FAST SIGNAL AVERAGING

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 85-87 manuscript received 21 Dec 78, final version 19 Jul 79

ZAYTSEVSKIY, I. L. and TURCHANIKOV, V. I., Kiev

[Abstract] Analog differentiators can be optimized using digital signal processing so that they show a high precision in the working-frequency range and a maximum noise suppression outside this range. Digital differentiators for this purpose have been described which measure the difference between adjacent readouts of the timewise digitized signal, with preliminary averaging of the signal with respect to the number of readouts, m . A frequency response is produced in this case close to the ideal response for a differentiator at frequencies below $1/mT_0$ (T_0 is the digitization period) with a sharp rolloff at frequencies above $1/mT_0$. Such a response is optimal for a real analog differentiator, because it provides for effective suppression of the high frequency noise for a set precision in the working passband. A block diagram is drawn for a proposed difference differentiator with fast signal averaging, in which the fast averaging of the input signal over the period T_0 is accomplished by means of an integrator with storage feedback designed around an op amp and a dynamic memory. The advantages of the proposed fast averaging technique are especially pronounced when differentiating signals containing large constant frequency pulsations in addition to the high-frequency noise. Such signals are characteristic of controlled rectifiers. When the differentiator digitization frequency is synchronized to the rectified (or reference) signal frequency, the rectifier circuitry is designed without a smoothing filter. This provides for maximum differentiation precision of the rectified signal with effective suppression of the interference. The proposed circuit was tested in a device for measuring the C-V characteristic, used in conjunction with a synchronous keyed detector in order to measure the partial derivative of the capacitance with respect to time for linear scanning of $V(t)$. 140UD14 op amps and 168KT2V control gates were employed. The digitization frequency (synchronized to the power mains) was 0.5, 5, and 50 Hz, the gain was 100, 10 and 1, the noise at the output (peak-to-peak) was 2, 0.5 and 0.5 mV and the minimum measurable value of the partial derivative of the voltage with respect to time was 0.5, 0.1 and 1 mV respectively. Figures 3; references: 3 Russian.
[120-8225]

COMPONENTS AND CIRCUIT ELEMENTS, WAVEGUIDES,
CAVITY RESONATORS AND FILTERS

UDC 621.372.8:621.378.325

TRANSFORMATION OF FIELD DISTRIBUTIONS BY A PLANAR OPTICAL MULTIMODE LIGHT GUIDE

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23,
No 11, Nov 80 pp 1322-1329 manuscript received 2 Jul 79

BRATCHIKOV, A. N. and GRINEV, A. Yu., Moscow Aviation Institute

[Abstract] A planar optical light guide of variable width and constant length is considered for transformation of the incoming amplitude-phase distribution of E- and H-modes. The light source, a single one or an array of infinitesimally narrow slits, simulates the exit aperture of an injection-type semiconductor laser. The results of a numerical analysis for paraxial modes in a homogeneous planar light guide with ideally conducting walls, assuming the laser radiation to be polarized normally to the p-n junction, are compared with experimental results. In the experiment a helium-neon laser and a light guide consisting of the polished inside surfaces of two quartz plates were used. The laser beam, after first passing through a collimator and a diaphragm, entered the light guide through a mask covering the entrance and movable across it. This mask consisted of an opaque chromium layer with a grating of 4-6 micrometer wide transmitting slits on a glass substrate. The results of this study have established the feasibility of new multielement radiator arrays consisting of synchronized laser oscillators and amplifiers with the possibility of synphasing their outgoing fields. Four such simple schemes are described. The authors thank V. G. Karnaukhov and V. A. Petrovskiy for the assistance in building the waveguide. Figures 6; references 5: 4 Russian, 1 Western.
[178-2415]

MODELS OF DISTRIBUTED MICROWAVE LOADS WITH SURFACE RESISTANCE

Moscow RADIOTEKHNIKA in Russian Vol 36, No 1, Jan 81 pp 64-66 manuscript received 14 Mar 80

KONIN, V. V. and BUTYRINA, L. A.

[Abstract] Resistors with surface resistance based on microwave are used in terminal matched loads, ballast loads, hybrid bridge devices and fixed attenuators. For dissipation of significant power, resistors are used with dimensions commensurate with the wave length of the microwave current flowing through the resistive layer. Consequently, during calculations the necessity appears for taking into account the length of the resistor. The present paper proposes models of distributed microwave loads constructed on the basis of resistors with surface resistance. An example is presented which demonstrates that taking account of the length of the resistor makes it possible to approximate a mathematical model to the actual. When the length of the resistor is not taken into account the maximum calculated and experimental characteristics of decoupling differ by 30%; the difference amounts to 1% when the length is considered. The proposed mathematical models make it possible to calculate the frequency characteristics of the most common microwave loads. It is possible to use these models for a choice of the optimum geometrical dimensions of resistors. Figures 3; references: 3 Russian.

[181-6415]

BALANCED FREQUENCY TRIPLER BASED ON SCHOTTKY BARRIER DIODES

Moscow RADIOTEKHNIKA in Russian Vol 36, No 1, Jan 81 pp 45-46 manuscript received 23 Jan 80

GRUNENKOV, A. A., KALININ, B. V. and KOROLEVA, N. A.

[Abstract] A balanced frequency tripler for the microwave band is proposed. The block diagram is presented of a circuit intended for frequency multiplication of an input signal by three and for joining with analogous frequency triplers without additional adjustment. The special features of its construction are considered and the results of an experiment are given. Figures 2; tables 1; references: 4 Russian.

[181-6415]

RIGOROUS DESIGN AND ELECTRODYNAMIC CHARACTERISTICS OF A DIAPHRAGM IN A CIRCULAR WAVEGUIDE

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 11, Nov 80 pp 1342-1350 manuscript received 28 Aug 79

KIRILENKO, A. A. and YASHINA, N. P., Institute of Radiophysics and Electronics, USSR Academy of Sciences

[Abstract] The analytico-numerical method of semi-inversion is used for calculating the electrodynamic characteristics of a diaphragm in a circular waveguide, the diaphragm constituting a step change in the cross section of the waveguide. The algorithm, essentially based on the problem of diffraction of an E_{0p} or H_{0p} wave, includes an analytical inversion of the singular part of the corresponding matrix operator and a successive solution of systems of linear algebraic equations of the second kind, or of the first kind in the extreme case of an infinitesimally thin diaphragm. The algorithm is efficient and ensures a fast relative convergence at all wavelengths up to the quasi-optical range. The dependence of the wave amplitude (transmission coefficient) on the ratio of large radius wavelength (frequency dependence) and on the ratio of small radius to large radius is calculated according to this algorithm. The accuracy of the Kirchhoff approximation is also evaluated against this rigorous algorithm. The results indicate that this method can serve as an effective tool for the design of waveguide components with a more intricate structure. Figures 3; references 7: 4 Russian, 3 Western. [178-2415]

PIEZOACOUSTIC TUNABLE RESONATOR

Moscow RADIOTEKHNIKA in Russian Vol 36, No 1, Jan 81 pp 54-56 manuscript received 28 Feb 80

PUGACHEV, Ya. N.

[Abstract] A tunable piezoacoustic resonator is considered, the resonance frequency of which can be changed over a relatively wide range of radio frequencies. It consists of two piezoquartz plates, the space between which (resonance chamber) is filled by a liquid with low acoustic losses. Such a resonator has pronounced frequency-selective properties because of the acoustic resonance in the volume of the liquid enclosed between the piezoquartz plates which serves as a converter of the electrical signal into acoustic oscillations and vice versa. The experimental characteristics of the resonator are presented. Figures 3; references: 2 Russian. [181-6415]

CONFERENCES, SEMINARS, EXHIBITIONS, SYMPOSIUMS

UDC 621.316.027.3:061.3

EIGHTH ALL-UNION SCIENTIFIC TECHNICAL CONFERENCE 'HORIZONS OF DEVELOPMENT OF HIGH VOLTAGE EQUIPMENT IN THE 11TH FIVE-YEAR PLAN' (20-22 MAY, 1980. SVERDLOVSK)

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 p 74

AFANAS'YEV, V. V., BRONSHTEYN, A. M. and UTKIN, A. I.

[Abstract] The meeting was called by the Central and Sverdlovsk boards of directors of the Scientific and Technical Society of the Power Engineering and Electrical Engineering Industry and the Ministry of the Electrical Engineering Industry and was chaired by professor V. V. Afanas'yev. About 400 delegates, representing scientific-research institutes and institutions of higher learning, design and planning organizations, enterprises and energy systems, participated in the meeting, presenting over 40 reports and communications at the plenary sessions. Among them were the following: A. P. Burman reported on the future of high-voltage equipment construction; N. V. Murashkov (Energoset'proyekt) and V. S. D'yachkov (Teploelektroproyekt) reported on future requirements imposed on high-voltage equipment; Yu. S. Satin and V. Ye. Shatrov (Soyuztekhnenergo) thoroughly analyzed the operation of domestic high-voltage equipment in energy systems. N. M. Adon'yev and R. B. Dobrokhotoy reported on research and development of domestic air breakers for all voltages. G. Ye. Agafonov read a paper on hermetically-sealed electric-gas distributing devices. Yu. A. Filippov reported on the state-of-the-art and future of power generator accessory equipment (breakers, decouplers, current transformers). B. I. Reder reported on the current status and outlook for high voltage technology and means of its improvement. The next meeting is planned for 1985.

[75-8617]

SCIENTIFIC TECHNICAL CONFERENCE 'PROBLEMS OF ELECTROMAGNETIC COMBINATION OF SEMICONDUCTOR POWER CONVERTERS' (30 OCT TO 1 NOV 1979, TALLINN)

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 p 73

TAMKIVI, P. I., chairman, organizing committee

[Abstract] More than 130 specialists participated in a conference organized by the Science Council on the Overall Problem of the 'Scientific Basis of Electrification and Electrical Power Engineering' of the USSR Academy of Sciences, and the Institute of Thermophysics and Electrification of the ESSR Academy of Sciences. The meeting was held in order to discuss specific scientific and technical problems associated with the generation and propagation of interference and undesirable harmonics in static converters, principles and methods of designing converters with minimal distortion and the theory and practice of applying power smoothing filters. Fifty-five reports and communications were read. The opening speech was given by P. I. Tamkivi (ITEF, ESSR Academy of Sciences) on some general aspects of electromagnetic matching of power converters. An overview of solid-state converters was given by I. V. Zhezhelenko and A. M. Lipskiy (Zhdanovskiy Metallurgical Institute). Most reports and communications dealt with the areas of analysis of thyristor circuit operation (inverters, variable rectifiers), and technical and economic questions of converters and the power supply. Another group of reports dealt with theory and practice of filters at the input and output of converters, and improved methods for design and planning of filters. The participants decided among others to focus on fundamental research including generation and propagation of individual components of the frequency spectrum; low-distortion converters; and interaction of converters and the power grid. [75-8617]

QUALITY CONTROL IN ALL STAGES OF RADIOELECTRONIC EQUIPMENT DESIGN AND PRODUCTION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 p 83

ZAYDEL', S. M.

[Abstract] A scientific and engineering seminar on "Quality Control in the Design and Production of Radioelectronic Systems in Automated Control Systems" was held on March 28th, 1980 in the "Computer Equipment" pavilion of the USSR Exhibition of National Economic Achievements in the ASU [automated control system] section A. V. Matveyev presented a report on "Optimal Standardization and Optimization of a Products Series". A report by V. S. Tselishchev was devoted to the organization and software for radioelectronic equipment quality control where limited engineering and economic data are available and the samples are truncated. E. N. Samokhvalov and N. A. Barkov treated questions of

automating the project planning of control systems: information and reference systems, quality control systems, teaching and dialog systems for automated planning. A. M. Machnev devoted a report to the analysis of the quality and characteristics of software for production planning and radioelectronic system quality control ASU's. V. Ya. Yatsuk and R. V. Khrapko dealt with questions of the design of a data bank in dialog systems for the control of the project planning and quality of products and systems. G. M. Goderzishvili presented a report on methods of testing and quality control of the software for quality control systems. The report of S. M. Zaydel' "Economic Engineering Calculations in Comprehensive Quality Control Systems" treated the acceleration of an entire production cycle from design through pricing. The seminar participants made recommendations to the Scientific and Technical Society for Radio Engineering and Telecommunications imeni A. S. Popov to expand the scientific work in this field.

[147-8225]

UDC 531.781.2:621.315

DYNAMOMETRIC TRANSDUCERS WITH SEMICONDUCTOR STRAIN GAUGES

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 1, Jan 81 pp 20-21

BEZZUBIK, O. N., candidate of technical sciences

[Abstract] Three dynamometric transducers with semiconductor strain gauges for measuring the hydrodynamic pulse loads on a ship propeller and its vibrations in a nonuniform wake are described which feature high accuracy and low noise. The first dynamometer placed inside the propeller hub consists of three gauges (one for two transverse forces, one for the axial force and the bending moment, one for the twisting moment), each with a strain gauge for conversion to electric signals. The second dynamometer measures the forces and the moments on an individual propeller blade only, therefore has a smaller mass of components mounted on the elastic element and thus also a wider frequency range. The third dynamometer combines the features of the other two. The natural frequency of all three devices is not lower than 300 Hz, the intercomponent interference level does not exceed 1-3%, and all are highly sensitive, yielding an output signal of 30-100 mV. Figures 3; references 3 Russian.
[209-2415]

UDC 531.787:621.315

A MINIATURE HIGH-TEMPERATURE DDP-1 PRESSURE TRANSDUCER

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 1, Jan 81 pp 21-22

ZAGANYACH, Yu. I., candidate of technical sciences, ZHILKA, V. A., candidate of technical sciences, and IVASHCHUK, T. M., engineer

[Abstract] A miniature pressure transducer with a $0-25 \cdot 10^5$ Pa range for operation at any temperature within the 0-250°C range is described. It includes a membrane not larger than 5 mm in diameter and an intermediate transducer with "Kremnistor" [silicon] type semiconductor strain gauges. The membrane converts

pressure readings to displacements and the strain gauges convert displacements to electric signals. The cylindrical housing with an external thread and a lid is made of stainless steel, adequate for protecting the elastic membrane (chromium-nickel alloy) and the strain gauges against detrimental action of the ambient fluid and against large momentary temperature rises. The device has been tested and calibrated against a plunger-type manometer; the temperature sensitivity of its output signal did not exceed 0.18%/°C over the 20-250°C range. Much development work was done at the Problem-Solving Laboratory for the Technology of Semiconductor Materials, L'vov Polytechnical Institute. Figures 2; references: 4 Russian.
[209-2415]

UDC 621.314.1.-52

DEVELOPMENT OF SINGLE CHANNEL CONTROL SYSTEMS FOR ELECTRONIC CONVERTERS

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 pp 14-21 manuscript received 24 Sep 70

BULATOV, O. G., candidate of technical sciences, LABUNTSOV, V. A., doctor of technical sciences, and PONOMARENKO, A. I., engineer. Moscow

[Abstract] The design of a single-channel phase control system (OSU) for electronic converters aims to reduce the number of parallel channels of phase shift of output pulses. This reduces the number of information conversion operations and enhances accuracy. The structure of the single channel control system is more flexible than that of multichannel systems. The new system basically differs from current ones in its method of synchronization, method of phase shift and method of distribution of output control pulses. The basic indicators of the OSU are the range of phase control, accuracy of conversion and speed. The most promising structures are shown in block diagrams. Figures 4; tables 1; references: 11 Russian.
[75-8617]

A PRECISION CONVERTER FOR SEMICONDUCTOR STRAIN GAUGES

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 1, Jan 81 pp 23-24

DMITRIYEV, V. A., candidate of physicomathematical sciences, and LAPIN, V. K., engineer

[Abstract] A precision time-pulse converter for pressure transducers with strain gauges has been developed which consists of a comparator and a Miller integrator operating with the strain gauges connected into a bridge circuit. The comparator includes an amplifier and the integrator includes two amplifiers: a power amplifier with a lower gain for the bridge supply and a differential voltage amplifier with a higher gain for the bridge output signal. Another amplifier inverts the bridge supply voltage to a 2-phase sawtooth voltage. All amplifiers are of the operational 140D1B or 15UD1 type, with KT315 and KT361 transistors. The converter operating time, determined by the RC circuit in the integrator and by the amplitude of the sawtooth voltage, is 2 ms under a nominal load and includes a 1 ms long initial period of conversion. The characteristic of the converter is linear within 0.03%, the temperature drifts of its slope and of the null point are, respectively, 0.05% and 0.03% per 10°C temperature change without a thermostat. Figures 2; references: 3 Russian.
[209-2415]

**ELECTRICAL ENGINEERING EQUIPMENT AND
MACHINERY: APPLICATIONS AND THEORY**

UDC 629-13:551-594.221

**MODEL STUDIES OF THE ROLE OF ELECTRIC CHARGING OF AN AIRCRAFT DURING THE
TRIGGERING OF LIGHTNING**

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 pp 50-52 manuscript received
14 Jan 80

BRANDENBURGSKIY, V. A., Moscow

[Abstract] An aircraft itself initiates lightning when leaders of different polarity travel from the opposite ends of the aircraft. When an aircraft acquires an excess unipolar charge, the electrical field generated and the external field of the clouds are added. The field intensity at one end of the aircraft increases and discharge conditions are created: at the other end, field strength intensity diminishes. Laboratory experiments tested this hypothesis. A metal cylindrical electrode 25 centimeters long and four centimeters in diameter was used as a model of the aircraft, with a discharge gap of two meters. Figures 2; references 5: 3 Russian, 2 Western.
[75-8617]

UDC 621.315.212.001.4

WAYS TO DESIGN PULSE-DUTY CABLES FOR HIGHER OPERATING VOLTAGES

Moscow ELEKTROTEKHNICA in Russian No 10, Oct 80 pp 24-27 manuscript received
4 Mar 80

PUSHKOV, N. V., candidate of technical sciences, RUMYANTSEV, D. D., candidate of technical sciences, and SOLOMONIK, S. S., candidate of technical sciences

[Abstract] Pulse-duty cables are used for transmission of high voltages from pulse generators to load circuits in radar, electrical forming processes, particle accelerators, and flashing light sources. They are generally designed for transmission of narrow, nearly rectangular or cosinusoidal pulses of

10^{-8} - 10^{-3} s duration. For all practical purposes, such cables can be regarded as long lines and their design be based on electrical as well as thermal performance requirements. A most important parameter here is the maximum electric field intensity the cable insulation can withstand, especially in cables with a characteristic impedance higher than 20 ohms, which depends on the strength of the insulation material, on the cable manufacturing process, and on the cable heating during operation. Modern cable technology has almost completely eliminated gaseous inclusions and with it erosion of the dielectric surfaces by discharges, but has also made electron emission from the conductor surfaces a dominant factor. The hypothesis that breakdown of the insulation occurs following an avalanche electron emission through the vacant spaces between molecules, rather than after formation of dendrites, is found to be consistent with measurements of the electrical strength of polyethylene as a function of the temperature and a function of the layer thickness. Confirmation of this hypothesis suggests, therefore, ways to raise the maximum permissible operating voltage for polymer insulation. It is essentially necessary to decrease the volume of vacant spaces, which can be achieved by impregnation with a liquid dielectric or by use of denser polymers such as an organosilicon or Teflon-4 fluorocarbon. It is also possible to inhibit electron emission by interposition of a layer of conductive polyethylene between conductor and insulation or by splitting the insulation into layers with radially varying density and electrical resistivity. Alternating such layers with monolithic shells is very effective. Figures 5; tables 1; references 9: 6 Russian, 3 Western (2 in translation). [160-2415]

UDC 538.574.4

ANALYSIS OF BACKSCATTERING IN A TURBULENT MEDIUM WITH MULTIPLE SCATTERING IN THE DIRECTION OF PROPAGATION TAKEN INTO ACCOUNT IN THE DIFFUSION APPROXIMATION

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 11, Nov 80 pp 1305-1313 manuscript received 4 Oct 79

SAICHEV, A. I., Gorkiy State University

[Abstract] Backscattering of electromagnetic waves by small-scale inhomogeneities in a randomly nonhomogeneous medium is analyzed in a diffusion approximation, taking into account not only multiple scattering by large-scale inhomogeneities in the direction of propagation but also a resulting loss of coherence. The diffusion approximation is more general than the Born approximation, inasmuch as it requires that scattering be small in one direction (from scattering point to observation point) only. This approximation is used for a statistical analysis on the basis of the standard equation of wave propagation through a randomly nonhomogeneous medium and, because the causality principle does not apply here, the vector field is replaced with its scalar analog and the reciprocity theorem is applied. Accordingly, the coherence function and amplification of the ray intensity are calculated for the Fresnel low-angle zone and a plane incident wave, both found to saturate as the scale of inhomogeneities becomes sufficiently large. The author thanks A. N. Malakhov for his interest in this study. References: 6 Russian.

[178-2415]

UDC 537.525.5-533.9

POSSIBILITY OF PLASMA FORMATION DURING THE INITIAL STAGE OF A NANOSECOND
HIGH-VOLTAGE VACUUM DISCHARGE FROM THE GAS DESORBED OFF THE FIELD-EMISSION
CATHODE

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVDENIY: RADIOFIZIKA in Russian Vol 23,
No 11, Nov 80 pp 1373-1377 manuscript received 31 Aug 79

LOBOV, S. I. and PAVLOVSKAYA, N. G.

[Abstract] An experimental study was made of nanosecond high-voltage discharges in a vacuum in order to explore the buildup of electrical conduction in the accelerating gap caused by plasma formation near the point cathode from the residual gas at its surface. Discharges were produced by 48-126 kV voltage pulses with a 1 ns risetime, generating a cathode current of 100-200 A in a circuit with a 40 pF capacitance. The evolution of these discharges revealed two phases: phase A corresponding to the initial stage of conduction at the pulse front and phase B corresponding to the later stage with the conduction increasing with higher gas pressure. The length of period A was found to decrease gradually to 2 ns with rising pressure and then sharply toward zero beyond that critical pressure, according to Paschen's law and depending on the electrode system (anode and cathode) geometry. The results, including evidence of primary glow, are consistent with the desorption mechanism of electrical breakdown in vacuum in a nonuniform electric field of 10^7 V/cm or higher intensity. Figures 3; tables 2; references 23: 15 Russian, 8 Western (1 in translation). [178-2415]

ENERGY SOURCES

UDC 621.351:537.22

CHARGING A WATER ENERGY ACCUMULATOR FROM A PLANAR EXPLOSIVE MAGNETOGENERATOR

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 pp 63-65 manuscript received
18 Oct 79

GERASIMOV, L. S. and IKRYANNIKOV, V. I.

[Abstract] Much experience has been gained in using purified, degassed water as a dielectric capacitive energy accumulator whose energy capacitance is governed by two factors: high dielectric penetrability and a substantial excess of pulsed electrical strength at times under than 10^{-6} seconds. Water has more than 14 times the energy capacitance of transformer oil. Because much of the advantage is lost due to the unwieldiness of charging devices, a promising charging device for the megajoule range may be an explosive magnetomagnetic energy. The following items are considered: 1) Electrical engineering model of the device and control of charging; 2) Operating stage; 3) Stage of discharge of inductive accumulator to water accumulator; 4) Calculation of magnitudes T , q and I ; and 5) Leakage of charge. An example is presented which is discussed in some detail. The explosive chamber costs several tens of thousands of rubles and the explosive magnetogenerator costs about 20 rubles, and consequently there are clear economic and technical advantages of this method over the pulse voltage generator method. Figures 5; references 7: 5 Russian, 2 Western (1 in translation).
[75-8617]

SOLAR ENERGY CONVERTERS USING GALLIUM ARSENIDE ANNEALED IN AN ALUMINUM SOLUTION

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 80 pp 71-76 manuscript received 25 Nov 79

AKHTYRSKIY, V. V., BAZYK, A. I., SUSHKO, B. I., TUZOVSKIY, A. M. and SHEPEL', L. G., Kiev

[Abstract] An experimental study was made of AlAs-GaAs heterostructures for photoelectric converters produced by isothermal annealing of GaAs in an aluminum melt. Crystals of n-GaAs(Te) and n-GaAs(Sn) with an equilibrium concentration $n = 10^{16} - 5 \cdot 10^{18} \text{ cm}^{-3}$ and a (100) orientation were used for annealing at constant temperatures over the 800-1000°C range in an Al-Ga-As melt with a high aluminum content (up to 15 wt.% Al). The thickness of the solid-solution layer, measured as a function of the annealing temperature and time, was found to increase at a decreasing rate with higher treatment temperature as well as with longer treatment time. The intensity of photoluminescence in the edge band, measured at 77 K before and after annealing, was found to be higher and almost independent of the carrier concentration in GaAs after annealing, but also to increase rapidly with increasing carrier concentration in GaAs before annealing. This points to the presence of aluminum in the GaAs melt as the factor responsible for a higher intensity of edge photoluminescence. This intensity was found, moreover, to decrease across the layer thickness. The results suggest that an AlGaAs solid solution forms at the GaAs surface, which tends to minimize the free energy of the system. Inasmuch as the solubility of gallium is unlimited and the solubility of arsenic is almost zero here, while the Al-As bond is stronger than the Ga-As bond, there occurs a conversion of GaAs to AlAs at their interface, either by diffusion from the solid GaAs or from its melt through the AlAs layer. Measurements of the spectral sensitivity of such n-n heterostructures revealed in both cases a sharp decrease of the sensitivity on both sides of the window corresponding to the absorption band. The second method of diffusion is preferable, because the resulting p-n junction will not be degraded by a jump in the impurity concentration within the surface region. Figures 5; references 16: 10 Russian, 6 Western.

[182-2415]

OPTIMIZATION OF TRANSLUMINANT COATINGS ON SILICON INVERSION-TYPE PHOTOELECTRIC CONVERTERS

Tashkent GELIOTEKHNIKA in Russian No 4, Jul-Aug 80 pp 23-26 manuscript received 8 Feb 79

TRET'YAKOV, A. P., Krasnodar

[Abstract] Two kinds of transluminant SiO_2 coatings are considered for silicon-type photoelectric transducers with an inversion layer: a single-layer film and a double-layer one including an inner layer. The design parameters, namely the thicknesses of all layer, are optimized with respect to maximum photocurrent. The calculations are based on the relation for the photocurrent as the integral of three spectral functions over the wavelength band of converter sensitivity: the photon flux density, the collection coefficient and the transmission coefficient. Both coefficients depend on the thicknesses of the layer involved and on the optical properties of their materials (absorption coefficient of the substrate, refractive index of the substrate and of each coating layer), the photocurrent also depending on the diffusion path length for minority carriers. Numerical results are shown including the loss factor, the latter not necessarily equal to but sometimes smaller than the reflection coefficient. For design purposes, the results of optimization are plotted graphically against the thickness of the coating layer (inner layer in the case of a double-layer coating). Figures 4; references 7: 3 Russian, 4 Western (1 in translation). [175-2415]

UDC 662.997:621.472

AUTOMATIC CONTROL OF THE HELIOSTAT FIELD IN A HIGH-POWER SOLAR ELECTRIC POWER PLANT

Tashkent GELIOTEKHNIKA in Russian No 4, Jul-Aug 80 pp 16-22 manuscript received 19 Feb 79

AKHROMENKO, G. Ye., DUBILOVICH, V. M., KRASNOVSKAYA, O. A., PED'KO, V. A., POLUNIN, A. V. and SHAPOVALOVA, N. A., Belorussian Branch, State Scientific-Research Institute of Power Engineering imeni G. M. Krzhizhanovskiy

[Abstract] An automatic control of the heliostat field in a solar electric power plant is analyzed. It ensures reliable normal operation of 90-95% of all heliostats at any instant of time, with not more than 30% of all servomechanisms operating simultaneously. Such a control not only includes turning ON at dawn at a preset threshold intensity of solar radiation ($150-200 \text{ kcal/m}^2\cdot\text{h}$), tracking

the visible sun position throughout the day, turning OFF upon a drop of the radiation intensity below a threshold caused by overcast, and turning ON again upon dissipation of clouds, but also regulation of the station power output by selective switching of individual heliostats, heliostat defocusing during emergencies, and other pertinent functions. One possibility is centralized control with a single or several SM-1(2) small computers and only the servomechanism drive or also, if necessary, the sensors mounted on the heliostats. Another possibility is independent control of individual heliostats under normal conditions and through SM-3(4) small computers in a CAMAC system under abnormal conditions. Although the first version is preferred now, imminent developments in special-purpose microprocessors favor a trend toward the second version. The control loop for normal operation with a sufficient intensity of solar radiation and no emergencies consists of a reflection sensor indicating the intensity of rays reflected by mirror surfaces, a function converter, an amplifier, a servomechanism with a speed reducer, and the heliostat. A wind sensor, a solar radiation sensor, and a fault sensor indicating any malfunction of the equipment can also be included. It is most expedient to have a stepper motor as the servomechanism drive. In this case the control loop also includes a logic module and a ring commutator. A sophisticated system of 3-level control for operation under the varying conditions is shown. It was designed for a 50 MW power plant, with one microprocessor at the first level, 120 microprocessors at the second level, and 2400 microprocessors at the third level, such a structure being realizable with adequate large-scale integration. Figures 4; references 10; 7 Russian, 3 Western.
[175-2415]

UDC 662.997:662.93

HIGH-VOLTAGE PHOTOELECTRIC GENERATORS WITH CONCENTRATORS OF SOLAR RADIATION

Tashkent GELIOTEKHNIKA in Russian No 4, Jul-Aug 80 pp 12-16 manuscript received 16 Mar 79

AFYAN, V. V., VARTANYAN, A. V., ZADDE, V. V., LITSENKO, T. A., STREBKOV, D. S. and UNISHKOV, V. A., All-Union Order of the Red Banner of Labor Scientific-Research Institute of Direct-Current Sources

[Abstract] An experimental study was made in order to determine the ultimate electrical performance characteristics of high-voltage photoelectric generators with latest technological improvements and with exposure to concentrated solar radiation. Three versions of such a generator were tested along with a planar photoelectric converter, for comparison: a matrix structure of n^+-p-p^+ microjunctions normal to the active surface and switched sequentially, one with a sawtooth structure of the active surface, and one with [-shaped p-n microjunctions. The temperature and the current-voltage characteristics were measured along with the directly incident solar radiation flux, a reading at each point

taken within 5-10 s. The power and the efficiency as function of the solar power density up to 850 kW/m^2 at an ambient temperature of $25-26^\circ\text{C}$ were then calculated from the data. Both the power and the efficiency were found to peak sharply at respective optimum values of the solar power density, and the short-circuit current to increase linearly with the solar power density over the entire range. This maximum efficiency is 14-14.7 within the $40-50 \text{ kW/m}^2$ range of radiation concentration in each case, but the new device with a saw-tooth active surface yields the highest output power: from about 220 microwatt at the maximum-efficiency point to about 600 microwatt maximum, with a much lower efficiency, at a solar radiation power of about 600 kW/m^2 . Figures 2; references 6: 4 Russian, 2 Western. [175-2415]

ATOMIC ELECTRIC POWER PLANTS WITH GAS-COOLED FAST REACTORS

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 4, Oct-Dec 80 pp 27-30

KLIMENTOV, V. B. [deceased], candidate of physicomathematical sciences, and PEDCHENKO, K. S., candidate of technical sciences, Kiev Institute of Nuclear Research, UkSSR Academy of Sciences

[Abstract] For several years much research has been done on the development of atomic electric power plants with gas cooling rather than liquid-metal cooling of fast breeder reactors. Such a cooling offers a better economy, more safety and reliability, although it is compatible with the use of uranium dioxide and plutonium dioxide as the fuel material in ceramic or cermet form inside steel, vanadium, or chromium jackets. Even the feasibility of using fuel rods made of metallic uranium, with a grain orientation or with a low alloy content, has been demonstrated to be compatible with gas cooling down to a 2-5% depletion at temperatures up to 500°C . The merits and the drawbacks of various gases and vapors such as water vapor, helium, carbon dioxide, nitrogen tetroxide, and aluminum hexachloride have been evaluated comparatively in terms of physico-chemical, physico-technical, energetical, and operational characteristics. The dissociable nitrogen tetroxide was found to be superior, a much more efficient heat carrier than helium or carbon dioxide and a much more efficacious gas-liquid than water in terms of turbine design and performance parameters. As an important guide to further development, a computer program has been written at the Kiev Institute of Nuclear Research for an overall system cost analysis covering atomic electric power plants from large pilot-industrial 300-600 MW ones to large modern or future 1000-1500 MW ones, with gas cooled reactors. Figures 3; tables 1; references: 5 Russian. [159-2415]

INSTRUMENTS, MEASURING DEVICES AND TESTERS, METHODS
OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

UDC 550.34.038.4:681.787

AN INTERFEROMETRIC LASER SEISMIC DETECTOR

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 108-109 manuscript
received 15 Jan 79

MASHINSKIY, E. I. and KHANOV, V. A., Novosibirsk

[Abstract] A seismic detector designed for seismic holography and prospecting is made in the form of a bore hole container which is lowered to depths of up to 20 m. The basis of the design of a Michelson laser interferometer consisting of a light source, a beam splitter, rotating mirrors with corner reflectors in the interferometer legs and a recording photodetector. An LG-56 He-Ne laser is the light source. A pressure change in the ground is registered as a change in the index of refraction of the air in the measurement leg of the interferometer. Tight contact with the rock is accomplished by means of a flexible casing. The temperature drift of the device is reduced and the contrast of the interferometric pattern is improved by making the length of the reference leg of the interferometer with a constant air pressure equal to the length of the measurement leg. A piezoceramic transducer is used to set the operating point in the center of the linear section in the reference leg and the changes in the optical difference in the travel in the interferometer legs are converted by the photodetector to an electrical signal which is fed via a cable to the above ground equipment. Estimates show that the pressure level in rock which can be measured by the detector for a measurement leg length of 300 mm and a ratio of the change in the photodetector current to the maximum current of 10^{-3} is 10^{-2} Pa. The static sensitivity was measured with a change in the level of a water column acting on the flexible case, and amounted to $0.25 - 0.35 \cdot 10^{-2}$ (v/Pa). The minimum output signal level, governed by the noise level of the photodetector and the contrast of the interferometric pattern, is about 1 mv. Brief results of field tests at a test site in the Omsk oblast are reported and it is noted that the instrument has proved to be quite reliable and registers weak waves reflected from deep geological boundaries. Figures 2; references: 2 Russian.
[120-8225]

A METHOD OF IMPROVING THE NOISE IMMUNITY OF INTEGRATING DIGITAL INSTRUMENTS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 55-64 manuscript received 19 Jul 78, final version 6 Mar 79

SHAKHOV, E. K., Penza

[Abstract] Traditional noise suppression based on the synchronization of the integration interval with the noise period is limited to rejection levels of 70 to 80 dB when applied to digital meters and A/D converters. Inasmuch as the resolution and linearity of digital meters makes it possible to distinguish up to $10^5 - 10^6$ gradations of the voltage being measured without switching ranges, a noise suppression of 100 to 120 dB is needed when the noise is commensurate with the useful signal if such high resolutions are to be meaningful. Recent efforts have been made to find other ways of boosting the noise immunity of integrating digital meters and A/D converters. One of the most promising is a technique based on the preliminary multiplication of the signal being integrated by a definite kind of weighting function. This paper proposes a possible synthesis of weighting functions which have a clear physical interpretation. The treated class of functions is limited to the set of step functions, because in the general case, the realization of a multiplication operation entails considerable technical difficulties here. The essence of the proposed method consists in the application of digital filtering algorithms usually employed in the synthesis of nonrecursive digital filters, i. e., algorithms which provide for summing with definite weighting coefficients delayed by the appropriate time intervals of the discrete values of the signal being filtered. The only special feature in this case is that it is not the discrete values of the filtered signal which are subjected to such operations, but rather the sliding integral from it, i. e. the discrete values of the output quantity of the integrating instrument. A detailed mathematical treatment derives expressions for the amplitude-frequency response of the devices as well as the weighting factors. The advantages are: 1) The algorithm provides a high level of interference suppression with rapid fluctuations in the frequency of the interference from the power mains; 2) The circuitry involved is simple, because with the fixed integrating interval, there is no need for a complex AFC circuit; and 3) It is faster, because the transient process in an AFC circuit cannot be less than two of the interference periods. The technique for processing the output information of an integrating digital A/D converter without the synchronization of the integration interval to the interference period and without increasing the conversion time boosts the interference suppression from 28 and 40 dB up to 60 and about 70 dB, respectively, for frequency deviations of the harmonic interference from the nominal values of 1 and 2%. The method can provide extremely high suppression in conjunction with the classical approach of synchronizing the integration time to the interference period; the suppression can be improved by as much as 70 dB in this case. Figures 5; references: 5 Russian.

[120-8225]

THE SPECTRAL CHARACTERISTICS AND ERRORS OF PHASE METERS USING DISCRETE ORTHOGONAL PROCESSING

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 50-55 manuscript received 6 Sep 79, final version 1 Feb 80

CHMYKH, M. K., Krasnoyarsk

[Abstract] When orthogonal signal processing is used for the measurement of phase shifts, two approaches are possible for digital meters: one where the multiplication and integration are performed at the analog level with subsequent A/D conversion and digital processing, and a second method using digitization and A/D conversion of the input signal directly, i. e., a discrete form of the signal processing algorithm. The second approach is the most promising, inasmuch as it allows for the use of microprocessors and precludes a number of instrument errors. This paper analyzes the errors of such digital phase meters which are caused by various kinds of noise. Expressions are derived for the measurement errors related to noise at frequencies which are multiples of the signal frequency (the error caused by nonlinear distortions of the signal) and the measurement error caused by noise which is spectrally concentrated at frequencies not multiples of the signal frequency, as well as the error caused by the impact of narrow and wideband normal noise. The purely theoretical treatment adduces neither sample calculations nor experimental verifications.

Tables 2; references: 3 Russian.

[120-8225]

ON THE MECHANISM OF THE OCCURRENCE OF BIREFRINGENCE IN A POLYCRYSTALLINE PLZT
SOLID SOLUTION IN THE CASE OF THE LONGITUDINAL ELECTROOPTICAL EFFECT

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 70-72 manuscript
received 28 Mar 79, final version 24 Jul 79

TROPIMOV, I. B., Moscow

[Abstract] While the transverse electrooptical effect or the effect of controlled birefringence in PLZT [lead lanthanum zirconate titanate] ceramics has been widely studied, the longitudinal electrooptical mode produces practically complete utilization of the surface of the working material, reduces the control voltage by an order of magnitude and makes it possible to obtain any configuration of the electrode structures of the activated element. Thermally depolarized, electrically polarized samples of a PLZT 8/65/35 fine grained polycrystalline solid solution in the form of disks 15 mm in diameter and 200 micrometers thick were studied. The polarization optical tests were made at room temperature at frequencies of 0.05 Hz and below. The samples were not clamped and the light sources were either a He-Ne laser or a halogen incandescent lamp. The test set-up made it possible to short out the electrodes of the samples being studied and the data were recorded using a photomultiplier and an X-Y plotter. The form and degree and polarization of the light at the output of the sample were ascertained. The occurrence of induced birefringence is demonstrated and qualitatively explained. The change in the intensity of the induced transmittance is of a threshold nature, which is caused by the step change in the induced birefringence. Birefringence in the sample is apparently caused by the occurrence of a transverse polarization component with the action an inverse piezoelectric effect in the sample. This can occur with a wedge shaped sample in which the motion of the electrical field intensity front is perpendicular to the light beam. The author thanks L. A. Shuvalov and K. I. Britsyn for valuable comments during a review of the manuscript, B. V. Ul'yanov for critical remarks during discussion of the work, as well as Ye. G. Fesenko for kindly granting specimens of a solid solution. Figures 1; references 13: 7 Russian; 6 Western.
[120-8225]

STRUCTURAL-MORPHOLOGICAL TRANSFORMATIONS IN As_2S_3 FILMS INDUCED BY ILLUMINATION AND HEAT TREATMENT

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 80 pp 85-91 manuscript received 5 May 80

DULEPOV, Ye. V., IVANCHENKO, V. A., TSUKERMAN, V. G. and CHERNYSHEVA, N. Yu., Novosibirsk

[Abstract] Vitreous arsenic sulfide as well as other chalcogenic glasses with a refractive index which can be varied are useful for recording and storage of optical information. Here a study of the recording process was made through examination with an electron microscope of structural and morphological transformations under illumination or heat treatment. Stoichiometric As_2S_3 films of controllable thickness were produced from amorphous material by direct heating with an electron beam under vacuum ($1 \cdot 10^{-3}$ Pa) and vapor condensation in a tantalum crucible on polystyrene substrates. Illumination was provided by an incandescent lamp, with an amount of light saturating the change of the refractive index. Heat treatment was effected in a furnace, under vacuum ($1 \cdot 10^{-3}$ Pa) and in air at a temperature close to the glass transition point and ensuring erasure of the recorded optical information. This temperature could be lowered if the heating time was lengthened appropriately. Structural examination was performed under a Tesla BS-513A electron microscope with an 80 kV accelerating voltage, and data on the electron diffraction were recorded with an EMR-100 electronograph. Direct translumination and gold-carbon replicas were used, as well as a combination of both techniques. An aqueous solution of dimethylamine in 1-10% concentrations had been found to reveal the structure of amorphous As_2S_3 and, therefore, was used here as etchant. On the basis of the results, a liquation model of optical recording on these films is proposed which explains such important features of the process as phase separation. The latter can be activated at various temperatures, the degree of separation increasing with a lower recording temperature. The authors thank T. I. Likholetova and R. R. Druganova for their assistance in this study, as well as V. G. Remesnik and V. F. Krasnov for helpful comments. Figures 4; references 30: 14 Russian, 16 Western.

[182-2415]

PHOTOELECTRIC PHENOMENA AND DEVICES,
ELECTROLUMINESCENCE, ION DEVICES

UDC 53.085.215:621.383.292

A MATHEMATICAL MODEL AND AN EXPERIMENTAL STUDY OF A PHOTOMULTIPLIER WITH
AFTERPULSES

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 3-10 manuscript received
9 Jul 79, final version 22 Oct 79

YERSH, I. G. and KOLESNIKOV, A. N., Novosibirsk

[Abstract] A photomultiplier with ion noise (having ion afterpulses) is treated as a device having a random instrument function; this function is defined as the photomultiplier response to one photoelectron, described here by a delta function. The random nature of the instrument function is caused by the randomness of the multiplication process and the transit times of the electrons and ions. The statistical approach derives analytical expressions for the correlation functions of the output pulse count rate and the number of pulses in a storage interval, taking into account the probability of afterpulses and the delay time distribution. The proposed photomultiplier model and the relevant equations are checked experimentally in order to ascertain the impact of afterpulses on the correlation function for a single electron flow of photomultiplier pulses. The 'quantakon' type FEU-130 photomultiplier was selected for the study because an amplitude distribution was anticipated for single electron pulses having a clearly pronounced single electron peak (inasmuch as the multiplication factor at the first gallium phosphide dynode is 20 or more) and the dynodes' configuration is characterized by a small scatter in the transit time of the electrons through a stage. The experimental set-up and data are described in detail; the values found for the probability of afterpulse appearance (their fraction of the overall number of pulses) are given in tabular form for multiplication factors of $0.5 \cdot 10^6$, 10^6 and $3 \cdot 10^6$ for four different FEU-130 photomultipliers. The FEU-130 is found to be close to the FW-130 made by ITT with respect to the probability of afterpulses and the delay time distribution function, and is better than the FEU-87 and FEU-51. When FEU-130's are used in photo correlation experiments for characteristic times of the processes under study of less than 20 microseconds (the time in which the delay distribution function goes to zero), afterpulses can greatly distort the correlation function of the signal if the count rate is low. The minimization of afterpulses reduces to the selection of the best quality photomultipliers and the choice of the optimum matching or the gain of the device and the electronic amplifiers. The authors thank V. M. Yesimov, A. M. Iskol'dskiy and V. S. Sobolev for helpful discussion. Figures 6; references 8: 6 Russian; 2 Western.
[120-8225]

HIGH-EFFICIENCY InGaAsP-InP HETEROPHOTODIODES FOR THE 1.0-1.6 MICROMETER BAND OF WAVELENGTHS

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 80 pp 82-84 manuscript received 13 Feb 80

GORELONOK, A. T., ZHINGAROV, M. Z., MAMUTIN, V. V., TIBILOV, V. K. and USIKOV, A. S., Leningrad

[Abstract] Two variants of isoperiodic InGaAsP-InP heterostructures were produced by epitaxy from the liquid phase on n-InP substrates with a carrier concentration $n = (2-7) \cdot 10^{17} \text{ cm}^{-3}$ and a B(111) or (100) orientation. The n-InP (pure and 5 micrometer thick) / p-InGaAsP:Mg (2 micrometer thick) heterostructures were built into planar photoreceivers and the n-InP (pure and 5 micrometer thick) / p-InGaAsP:Mg ($p = 7 \cdot 10^{16} - 3 \cdot 10^{17} \text{ cm}^{-3}$ and 2-3 micrometer thick with $E_g = 0.8-1.0 \text{ eV}$) / p-InP:Mg ($p = 10^{18} \text{ cm}^{-3}$ and 3 micrometer thick) heterostructures were built into mesa photoreceivers, with Au-Zn contacts at the n-region and Au-Te contacts at the p-regions. Measurement of their capacitance-voltage characteristics yielded a linear $1/C^2 = f(V)$ relation in both cases, indicating a 0.1-0.3 micrometer thick space charge region inside the epitaxial solid solution. The external quantum efficiency was found to reach a high plateau of 40-45% over the $\lambda = 1.0-1.6 \text{ micrometer}$ ($h\nu = 1.25-0.8 \text{ eV}$) range for the planar devices and 42-55% over the $\lambda = 1.0-1.3 \text{ micrometer}$ ($h\nu = 1.25-0.9 \text{ eV}$) range for the mesa devices. The authors thank Zh. I. Alferov for his steady interest and V. I. Korol'kov for his helpful comments, as well as B. V. Yegorov and B. I. Il'ina for their assistance in preparing the specimens. Figures 2; references 10: 4 Russian, 6 Western. [182-2415]

PHOTOEMISSION CHARACTERISTICS OF p-GaAs:Cs, O₂ FILMS PRODUCED BY MOLECULAR-BEAM EPITAXY

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 80 pp 69-71 manuscript received 28 Apr 80

BUDARNYKH, V. I., KALININ, V. V. F. and RYABCHENKO, V. E., Novosibirsk

[Abstract] Epitaxial layers of p-GaAs doped with beryllium to a hole concentration $p = 5 \cdot 10^{18} \text{ cm}^{-3}$ were grown by molecular-beam epitaxy on GaP substrates with a (100) orientation directly, without a conventional buffer layer, for a study of their photoemission characteristics after activation of the cathode with cadmium and oxygen. Measurements of the photoemission spectrum of such p-GaAs/GaP:Cs, O₂ cathodes produced under optimum technological conditions

revealed a sharply decreasing quantum yield at wavelengths longer than 0.88 micrometer, the quantum yield of the same cathodes activated with cadmium alone being approximately one order of magnitude lower. With the absorption coefficient also measured in the same optical system, the diffusion path could be calculated rather accurately and was found to be approximately 0.2 micrometer long with a $B = 0.17$ probability of egress. The measurements also revealed a high degree of crystallographic perfection, with a sharp 0.88-0.91 micrometer peak corresponding to a half-width of 0.2 eV at room temperature. The results indicate that p-GaAs films produced by molecular-beam epitaxy yield photocathodes of no worse quality than do p-GaAs films produced by other methods with a buffer layer. Figures 3; references 8: 1 Russian, 7 Western. [182-2415]

UDC 621.396.624

A PHOTOMULTIPLIER WITH SIGNAL NORMALIZATION FOR LASER SPECTROMETERS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 81-82 manuscript received 28 Sep 79

SAPRYKIN, E. G. and SOROKIN, V. A., Novosibirsk

[Abstract] Of the possible approaches to obtaining undistorted spectral characteristics in laser spectrometers, the use of an electronic normalizing circuit during signal registration is best, because analog devices can be used to normalize a signal, which is quite convenient when recording nonlinear resonances using the modulation method. This paper describes the design and performance of a simple photomultiplier for the normalization of the variable portion of a signal by a constant component. This is accomplished by varying the voltage applied to the last four dynodes of a photomultiplier tube; the voltage is controlled by an inverting DC amplifier. The circuit is simple, employing three transistors and four diodes with a few resistors and capacitors. The performance of the units was checked by intensity modulation of a laser at 2 Hz. The laser power was varied in order to simulate the change in the constant component with tuning of the probe radiation frequency. With the normalization circuit switched in, the signal is proportional to the depth of modulation of the radiation and is insensitive to a change in its constant component. The precision of the normalization is within 1% and it is noted that analog circuits of similar precision are enormously more complicated. The device was successfully used in a laser spectrometer in order to record difference and 'field' resonances. Figures 2; references: 4 Russian. [120-8225]

PUBLICATIONS, INCLUDING COLLECTIONS OF ABSTRACTS

NEW STATE STANDARDS FROM GOST

Moscow ELEKTRICHESTVO in Russian No 9, Sep 80 p 75

State Standards Press Center--Concerning Materials of VNIKI [All-Union Scientific-Research Institute of Technical Information, Classification and Coding of the State Committee of Standards, Measures and Measuring Instruments]

[Abstract] GOST 1282-79Ye. Capacitors for an increase of the power coefficient of 50 and 60 Hz AC electrical installation, replacing GOST 1282-72, valid from 1 Jan 81 until 1 Jan 86; rated voltages increased to 0.23 to 21 kV replacing 0.22 to 10.5 kV; rated powers increased to 1 to 200 replacing 4 to 100 kV.A; rated frequency of 60 Hz; ambient temperature lowered to -60°C replacing -40°C; increase of the probability of reliable operation of capacitors for 15-20 years up to 0.9 instead of 0.8 and service life increased from 20 to 25 years.

GOST 7207-79Ye. Three-phase transformers for steel smelting arc furnaces, replacing GOST 7207-70 valid until 1 Jan 81. A number of rated powers of transformers are extended to 125,000 instead of 80,000 kV.A; peak values of secondary voltage in idling transformers of rated power of 630 kV.A extended to 50,000 kV.A; values of rated primary voltages of transformers with rated power of 8000 and 32,000 kV.A extended to 80,000 kV.A.

[75-8617]

UDC 539.293.536.45

CALCULATION OF THE PROCESS OF RECORDING NONSTEADY-STATE HOLOGRAMS IN VANADIUM DIOXIDE FILMS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 110-112 manuscript received 19 Jun 78

KAPAYEV, V. V., Moscow

[Abstract] Based entirely on a model for holographic storage in VO_2 from a previous paper by the author [Kapayev, V. V., Timerov, R. Kh., AVTOMETRIYA, 1978, No 2, p 17], the process of nonsteady-state hologram storage is treated theoretically assuming a heating mechanism for the light induced phase transition in the material, similar to the previous proposal for holograph writing with subsequent storage (steady-state holograms). A dynamic mode is possible if the ambient temperature corresponds to the region below the temperature for the completion of the return leg of the hysteresis loop of the physical properties of the VO_2 film. An expression is found for the temperature field which is subsequently used to compute the diffraction efficiency, needed to account fully for the specific features of the phase transition. The change in the diffraction efficiency is plotted as a function of time during the exposure of the film to the laser write pulse (18 to 40 microseconds after the pulse is triggered) and after the completion of the write pulse (0.4 to 2.0 microseconds after t_0) where the former graph shows the rise in the efficiency up to about 1.4%, and the second, its subsequent decline to zero. The decay time of diffraction efficiency is plotted as a function of the spatial frequency of the hologram for a value of the coefficient of heat exchange between the film and the environment of $10^6 \text{ watt}/(\text{cm}^3 \cdot \text{deg})$ and values of write pulse energies of 130 to $400 \text{ J}/\text{cm}^3$. The diffraction efficiency decay is also graphed as a function of the heat exchange coefficient for various hologram spatial frequencies. The behavior of these curves is discussed and a technique is indicated for calculating the diffraction efficiency decay time for specific experimental conditions and arbitrary spatial frequencies. No sample calculations are provided. The author thanks L. S. Mednikov for assistance in conducting the numerical calculations. Figures 3; references 4: 3 Russian; 1 Western. [120-8225]

CALCULATION OF POWER AND THRESHOLD CHARACTERISTICS OF SINGLE- AND DOUBLE-CAVITY PULSE LASERS ON THE BASIS OF APPROXIMATE DYNAMIC EQUATIONS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 11, Nov 80 pp 1288-1294 manuscript received 7 Sep 79

KHOLODNYKH, A. I., Moscow State University

[Abstract] The system of approximate dynamic equations of pulse lasers is reduced to one equation for a single-cavity resonator and another one for a double-cavity resonator, with the emission intensity normalized to the threshold pumping intensity and the relaxation time normalized to that of a "cold" resonator cavity. A non-linear medium with a given refractive index is assumed to fill a cavity completely and the intensity reflection coefficient to be $R = 1$ at the entrance mirror but $R = 1$ at the exit mirror. On this basis the quantum efficiency of conversion, which determines the emission threshold, as well as the energy efficiency and the power efficiency of both types of laser are calculated. The transverse distribution of pumping intensity is first assumed to be uniform and then to be Gaussian. Numerical calculations were made for both types of laser on a crystal of lithium niobate with second-harmonic pumping from a garnet laser. The results, for constant pumping intensities of 50 and 100 mW/cm², respectively, show how the maximum power, the maximum quantum efficiency, and the optimum reflection coefficient at the exit mirror vary with the duration of the pumping pulse of a fixed energy and with the intensity of the pumping pulse. The results indicate that there is an optimum duration of the pumping pulse, for maximum conversion efficiency, which becomes longer with lower pumping intensity and remains longer for a single-cavity resonator than for a double-cavity one. The author thanks S. A. Akhmanov for helpful discussion and Z. O. Guzeva for assistance in performing the calculations. Figures 4; references 8: 5 Russian, 3 Western. [178-2415]

SPECTRUM OF THE SPACE COHERENCE FUNCTION OF THE FIELD OF A LASER BEAM IN A TURBULENT ATMOSPHERE

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 11, Nov 80 pp 1282-1287 manuscript received 2 Jan 80

BELEN'KIY, M. S., BULDAKOV, V. M. and MIRONOV, V. L., Institute of Atmospheric Optics, Siberian Department of the USSR Academy of Sciences

[Abstract] A laser source and a receiver lens are considered to be a large distance apart in a randomly nonhomogeneous medium such as a turbulent atmosphere.

The spectrum of the second-order mutual-coherence function in the Debye relation for the mean intensity in the focal plane of the lens is evaluated for a spatially bounded laser beam. Calculations by the rigorous asymptotic method are based on the integral representation of this function and the two extreme cases of a very small and a very large parameter, respectively, which characterize the structure of atmospheric turbulence. Numerical estimates made with a rectangular correlation window for phase fluctuations of the laser beam intensity, with its amplitude fluctuations disregarded, reveal that the spectrum of the coherence function in the high-frequency range of strong intensity fluctuations depends largely on the structural parameter of atmospheric turbulence. It thus appears possible to estimate the internal turbulence scale in the atmosphere by transilluminating the latter with a laser beam. In the case of a very small turbulence parameter the spectrum of the coherence function will contain anomalies due to the spatial boundedness of the laser beam and will thus differ from the spectrum which characterizes other modes of radiation such as an unbounded plane wave. Figures 1; references 12: 10 Russian, 2 Western (1 in translation). [178-2415]

UDC 681.327

REVERSIBLE INFORMATION STORAGE IN VO₂ FILMS

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 80 pp 96-100 manuscript received 29 Jan 78

BUTROV, V. Ya., IGNAT'YEV, A. S., KAPAYEV, V. V., MOKEROV, V. G. and PETROVA, A. G., Moscow

[Abstract] An information storage of large capacity has been designed with VO₂ films for recording, retention, readout, and selective erasure of holograms. It comprises a matrix of 32 x 32 cells assembled in 16 lines, each line consisting of 64 memory elements in 2 rows. Each cell is a SiO₂(substrate)/SnO₂(heater)/SiO₂(insulator)/Ni/VO₂ sandwich for operation in the reflection mode or a SiO₂(substrate)/VO₂/SiO₂(insulator)/SnO₂(heater) sandwich for operation in the transmission mode. The substrate material is quartz, the heater layer consists of two transparent resistive SnO₂ regions with contacts for passage of electric current (Joule effect) during data retention, and the thin nickel layer is added for increasing the diffraction efficiency through interference effect during readout. Erasure is effected by power turn-off so that the temperature of the VO₂ film under the SnO₂ heater drops to a level which corresponds to the end point of the descending path along the hysteresis loop. The performance of this device is calculated on the basis of the equation of steady-state heat conduction for a parallelepiped and its solution, the temperature profile over the surface of a memory cell, found as the sum of a constant term and a series of trigonometric-hyperbolic terms. The performance of VO₂ (0.05-0.2 micrometer thick) - SnO₂ (0.1 micrometer thick) - SiO₂ (0.6-0.8 micrometer thick) - Ni(0.2 micrometer thick)

devices was tested with instruments including a solid-state laser with an ionic frequency converter at $\lambda = 0.53$ micrometer for recording, a He-Ne laser for readout, a light beam splitter, a set of two mirrors, a photoelectron multiplier, an oscillograph, a master oscillator and a control circuit. With this apparatus were measured the dependence of the diffraction efficiency on the energy of a recording laser pulse and on the space frequency as well as the dependence of the erasure time on the difference between the storage (heater) temperature and the substrate (thermostat) temperature. Figures 5; references 6: 3 Russian, 3 Western.
[182-2415]

RADARS, RADIONAVIGATION AIDS,
DIRECTION FINDING, GYROS

UDC 621.396.9

THE FALSE ALARM REPETITION RATE AND THE OPTIMIZATION OF THE PARAMETERS OF A
BINARY MOVING WINDOW DETECTOR

Journal RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 37-39 manuscript
received after completion 2 Jan 80

BOL'SHAKOV, N. A.

[Abstract] Detector efficiency in the case of simultaneous detection and measurement of radar return parameters can be estimated in terms of a specified false alarm probability or repetition rate of the false alarms. When the latter are used to establish the functional relationships between a threshold signal and the detector parameters, and then these functions are compared with the relationships where the former condition is used, it is necessary to ascertain the relationship between the repetition rate of the noise spikes and the detector parameters. This rate can be written as a function of the average pulse width of the noise spikes, K ; this paper derives an analytical expression for K using a Monte-Carlo technique because of the computational difficulties caused by the multiply-connected nature of the processes in moving window detectors. The expression estimates the maximum sensitivity of a detector and the level of signal losses when the detector parameters deviate from optimal values for specified repetition rate of the noise spikes. Figures 3; references 6:

5 Russian; 1 Western.

[147-8225]

OPTIMUM PROCESSING OF SIGNALS IN SHORT-RANGE NAVIGATION RADIO ENGINEERING SYSTEMS

Moscow RADIOTEKHNIKA in Russian Vol 36, No 1, Jan 81 pp 29-32 manuscript received 7 Apr 80

MIRONOV, M. A. and KORSAKOV, A. N.

[Abstract] The paper demonstrates that it is possible to attain a further increase of the precision and noise immunity of existing short-range navigation radio engineering systems (SNRS) by the use of optimum algorithms for processing of signals synthesized on the basis of the Markov theory of optimum nonlinear filtration advanced by R. L. Stratonovich (Moscow State University, 1966). Algorithms for processing of signals in the range-finder channel are considered, taking into account the fact that the pulse signals which appear at the input of the range finder and azimuth channels of the SNRS differ only by the form of the envelopes. Figures 2; references: 7 Russian.
[181-6415]

UDC 548.4-143:548.25

MICROINCLUSIONS OF THE SOLVENT IN EPITAXIAL STRUCTURES GROWN FROM THE LIQUID PHASE

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 80 pp 32-37 manuscript received 16 Jan 80

VASILENKO, N. D., L'YACHENKO, A. M., MARONCHUK, I. Ye. and MARONCHUK, E. Ye.,
Odessa

[Abstract] Microinclusions of the solvent in epitaxial GaAs layers grown from the liquid phase in a finite volume of gallium, indium, or tin melt on high-resistivity (10^7 ohm.cm) GaAs substrates with a (111)A orientation were studied experimentally by methods involving phase transitions of the first kind. The specimens for this experiment had been produced with a high degree of surface perfection, with the dislocation density not exceeding $1 \cdot 10^4$ cm⁻². The temperature dependence of microhardness and mechanical stresses were measured by the optical-polarization method, with the aid of a Senarmon compensator. The thermograms reveal changes which occur near and at the melting-crystallization point, i. e., jumps of microhardness and hysteresis of residual stresses. The entrapment of solvent particles is attributable to two causes. The first cause is polycentricity of the crystallization process, because of a low energy of nucleation at the crystal-liquid interface and because of morphological instability of the crystallization front, with attendant subcooling determined by the concentration gradient. The second cause is inevitable local nonstoichiometry in binary compounds, with resulting migration of interstitial atoms of the excess element and differences in the coefficient of thermal expansion. Both mechanisms are analyzed here, for an interpretation of the experimental data. Figures 3; references 19: 13 Russian, 6 Western.
[182-2415]

INDIUM-GALLIUM-ARSENIC-PHOSPHORUS SOLID SOLUTIONS, ISOPERIODIC WITH INDIUM PHOSPHIDE

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 80 pp 11-21 manuscript received 22 Dec 79

BERT, N. A., GORELENOK, A. T., DZIGASOV, A. G., KONNIKOV, S. G., POPOVA, T. B., TARASOV, I. S. and TIBILOV, V. K., Leningrad

[Abstract] The constitution diagram of In-Ga-As-P quaternary solid solutions was studied over the entire range of isoperiodicity with the InP compound (0.078-2.8 atom.% Ga, 0.8-6.8 atom.% As, 0-0.85 atom.% P), in a search for ideal heterostructures with matched lattice parameters and coefficients of thermal expansion. The characteristics of epitaxial growth of these solid solutions from the liquid phase on InP substrates were also studied in order to determine the optimum conditions for growth of light-emitting and photoreceiver layers. The specimens for this experiment were prepared in an atmosphere of pure hydrogen from GaAs and InAs, in a furnace with a heat pipe and forced cooling at a variable rate from 0.17 to 2°C/min. As the material for substrates served pure n-InP with an electron concentration $n = (1-6) \cdot 10^{16} \text{ cm}^{-3}$, a dislocation density of $10^4-10^5 \text{ cm}^{-2}$ and an orientation in the crystallographic (111)B or (100) plane. Solutions-melts were produced by dissolving GaAs and InAs in indium at 660°C for 30 min. The solubility of phosphorus was monitored by the loss-of-weight method. The photoluminescence of thus grown layers was measured at 300 and 77 K by the method of synchronous detection, with a He-Ne laser serving as the excitation source. Also measured were the energy gap and, by x-ray spectral analysis, the As, Ga, P concentrations in the solid phase as functions of the As concentration in the liquid phase. The surface morphology was examined under an electron microscope. The results indicate that In-Ga-As-P solid solutions make better heterostructures than InP for light emitters. The authors thank Zh. I. Alferov for his steady interest, and D. Z. Garbuzov and P. S. Kop'yev for their helpful comments. Figures 8; tables 1; references 31: 14 Russian, 17 Western. [182-2415]

THE OPERATIONAL MODES OF GUNN DIODE OSCILLATORS AT POWER SUPPLY VOLTAGES CLOSE TO THE DIODE THRESHOLD VOLTAGE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 12, Dec 80 pp 44-47 manuscript received after completion 25 Mar 80

GONCHAROV, B. A., MAMZELEV, I. A. and TUZOV, V. M.

[Abstract] The following equivalent circuit of a Gunn diode is analyzed: the GaAs chip is connected to a parallel resonant circuit composed of the reactive parameters of the chip and the diode package. This diode structure is in turn inserted in a microwave resonant circuit which takes the form of a capacitor of several tens of pF. At voltages close to the threshold voltage of the chip, low frequency oscillations can appear in the supply circuitry simultaneously with the microwave oscillations. An analytical expression is found for the signal voltage across the domain capacitance which makes it possible to determine the form of the natural oscillations in the low-frequency resonant circuit consisting of the structural capacitance and the inductance of the power supply leads. The analytical description of the behavior of such oscillators is confirmed by a study of 3 cm band Gunndiode oscillators. The oscilloscope traces of the low-frequency voltage is shown along with the volt-ampere characteristic of the chip when the supply voltage is raised and lowered. The region of low frequency oscillation when the voltage increases is somewhat wider than when it decreases; a break in the low frequency oscillations with a voltage drop occurs at the moment when the voltage is below the threshold level, something which produces regions of bistability. The operation of an oscillator with an external inductance were also studied experimentally using a self-oscillator in the low frequency range. The volt-ampere characteristic of this keyed type circuit for the Gunn diode model was obtained using a transistorized keyer. It is shown that in a self-excited oscillator with two tuned circuits having a keyed type volt-ampere characteristic, bistable excitation modes are possible along with the simultaneous generation of two frequencies, similar to the phenomenon observed in some microwave oscillators using Gunn diodes. Figures 5; references: 3 Russian.

[147-8225]

A SIMPLE MODEL OF AN MOS TRANSISTOR FOR THE AUTOMATION OF THE CIRCUIT DESIGN
PLANNING OF INTEGRATED CIRCUITS

Novosibirsk AVTOMETRIYA in Russian No 5, Sep-Oct 80 pp 102-105 manuscript
received 27 Dec 79

TSYTENKO, V. B., Novosibirsk

[Abstract] A one-dimensional Poisson equation is usually solved when modeling the statistical characteristics of an MOS transistor and simple expressions can be derived to describe the steep region of the volt-ampere characteristics [VAC] by using some simplifications which do not substantially affect the model precision. However, Poisson equations do not apply to the gently sloping region (saturation) of the VAC of an MOS transistor because the condition for the continuous approximation of the channel is violated. The known two-dimensional models are complex and efforts to simplify them reduce the precision, requiring the use of empirical parameters. Accordingly, this paper proposes a MOS transistor model which permits the description of the steep and gently sloping regions of the VAC using a single analytical expression. The model also takes into account the slope of the VAC as a function of the gate voltage. Methods of calculating model parameters using experimental VAC's for test transistors with different photolithographic channel lengths (a long one of 24 micrometers and a short one of 4) are analyzed. The two techniques of model parameter computation are compared; the modeling was accomplished along with the automated retrieval and processing of the experimental data using a set of routines for the disk operating system of the M-6000 computer. Good agreement is noted between the proposed simple method and a proposed optimization technique. The experimental characteristics of the MOS transistors are used to check and refine the MOS model while the calculated values of the model parameters are the raw data for the analysis programs for the basic electrical schematics of the IC's.

Figures 1; tables 1; references: 2 Russian.

[120-8225]

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